REDESIGN OF TAKADA RADIO USING BOOTHROYD DEWHURST DFA METHOD

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EXAMINERS APPROVAL DOCUMENT

UNIVERSITI MALAYSIA PAHANG
FACULTY OF MECHANICAL ENGINEERING

We certify that the project entitled "*Redesign of Takada Radio Using Boothroyd Dewhurst DFA Method"* is written by *Mohamed Kader Maidin B. Y.Shahari*. We have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. We herewith recommend that it be accepted in partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering with Manufacturing Engineering.

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Examiner	Signature

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Manufacturing Engineering.

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STUDENT'S DECLARATION

I declare that this thesis entitled *"Redesign of Takada Radio Using Boothroyd Dewhurst DFA Method"* is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurently submitted for award of other degree.

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To my Beloved Family

Y.SHAHARI BIN YUSOF

NOORJAHAN I/K Y.SHAHARI

SEENIRISWANA BEGUM BINTI Y.SHAHARI

RIAS FATHIMA JAHAN BINTI Y.SHAHARI

KATHER SHARIFA BINTI Y.SHAHARI

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ABSTRACT

The present paper discusses the Boothroyd Dewhurst DFA method that been used to evaluate a radio named Takada radio based on assembly efficiency. A survey conducted by distributing questionnaire about Takada radio to the university students and manufacturing company workers. Original design of Takada radio is analyzed and redesign of Takada radio is created based on improved assembly efficiency. Main thing evaluated in this project on Takada radio is the total assembly time and cost, and percentage of design efficiency. ALGOR software analysis is used to evaluate the reliability of the integral fasteners that have been designed in the redesign of Takada radio. The integral fasteners are analyzed on whether it will break or failure under range of forces acted on the integral fasteners. The redesign of Takada radio with the higher percentage value of design efficiency is selected as the best design in term of its assembly efficiency.

ABSTRAK

Kertas projek ini membincangkan cara Boothroyd Dewhurst DFA yang telah digunakan untuk menganalisis radio yang bernama radio Takada dari aspek pemasangan komponen radio tersebut dengan efisien. Satu survey telah dibuat dengan mengagih soalan-soalan tentang radio Takada kepada pelajar universiti dan pekerja di kilang pembuatan. Rekaan asal dan rekaan baru radio Takada dianalisis dari segi pemasangan komponen dengan efisien yang lebih baik. Perkara utama yang dambil kira dan dianalisis dalam projek ini adalah jumlah masa dan kos untuk memasang radio dan pemasangan komponen efisien dalam nilai peratus. Analisis daripada perisian ALGOR telah digunakan untuk menilai tahap ketahanan pengetat yang telah dimasukkan dalam rekaan baru radio Takada. Pengetat dianalisis dari segi sama ada ia patah or bengkok apabila dikenakan daya dalam had tertentu. Rekaan baru radio Takada dengan nilai pemasangan komponen efisien yang tinggi dipilih sebagai rekaan terbaik dari segi pemasangan komponen efisien.

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E_{ma}	Design efficiency
Nmin	Theoretical minimum number of parts
Ta	Total assembly time
Tma	Estimated time to complete the assembly of the product
E	Assemblability evaluation score ratio
K	Assembly cost ratio
α	Rotational symmetry of a part about an axis perpendicular to its axis of insertion
β	Rotational symmetry of a part about its axis of insertion

LIST OF ABBREVIATIONS

NM	Theoretical minimum number of parts
TM	Total assembly time
DFA	Design for Assembly
DFM	Design for Manufacture
DFMA	Design for Manufacture and Assembly
AEM	Assemblability Evaluation Method
HR	Handling ratio

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter discussed about the project background such as problem statement, objectives and scope of the project. All this information is important to give a starting point for the progress in this project. This project is focused on improving a Takada radio based on the assemble efficiency using a Boothroyd-Dewhurst DFA approach.

1.2 PROJECT BACKGROUND

Design for manufacture and assembly (DFMA) is a combination of design for assembly (DFA) and design for manufacture (DFM). The term DFMA is defined as a set of guidelines developed to ensure that a product is designed so that it can be easily and efficiently manufactured and assembled with a minimum labor effort, assemble time, and cost to manufacture the product. During a product development, DFMA method ensures that the transition from the design phase to the production phase is smooth and rapid as possible.

Generally, there are three DFA methods used to reduce the cost of the product. The main methods are Boothroyd-Dewhurst DFA method, Lucas-Hull DFA method, and Hitachi Assembly Evaluation Method (AEM). These three methods have been discussed in Chapter 2.

This project is about applying Boothroyd-Dewhurst DFA method to redesign the radio to make it better than the previous design in the aspect of assembly efficiency. This case study focused on redesigning the Takada radio and the aim of the analysis is to evaluate the redesign radio in term of the assembly efficiency.

1.3 PROBLEM STATEMENT

Radio normally consists of high number of components. In industries, the radio components are assembled together to produce final radio product. During assembly process, some intricate components are difficult to be assembled. This intricate component also need more time to be assembled and as a result, the cost to assemble the radio has been increased.

In solving the increasing cost of radio assembly, this project is done. The project also aims to minimize the difficulties encountered during assembly of the components of the radio. At the same time cost of the radio also aimed to be reduced. The radio is chosen as a product in this project because radio seems to have a lot of intricate components and also high number of components. The radio also has many areas that can be improved in term of design efficiency. Name of the radio chosen is Takada radio and it consists of 63 components that including radio parts and fasteners. Those components are chosen within the scope of the project only.

1.4 PROJECT OBJECTIVES

The objectives of this project are determined. There are three objectives have been defined to be focused on and to simplify the project as stated below:

1. To redesign the radio for improved assembly operation.
2. To analyze the original radio design and redesign based on the assembly efficiency.
3. To select the best redesign of radio based on the assembly efficiency.

1.5 SCOPE OF STUDY

The following scopes of the project are determined in order to achieve the objectives of the project:

1. The design of the original Takada radio and the redesign of the Takada radio are done using designing software which is the Solidwork 2006 software.
2. Analysis of the original design and the redesign of the Takada radio are performed using Boothroyd-Dewhurst DFA method.
3. Electrical and electronic parts in the radio such as circuit board are selected as one part because it is too complicated. The parts are assumed to be assembled as a one part.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discussed about the DFA and its guidelines. Besides that, the literature review gives a brief explanation about the functions and the principles of the DFA which is subcomponent of the DFMA itself. Some of the information in this chapter can give extra information which can be useful while doing this project.

2.2 DESIGN FOR ASSEMBLY (DFA)

Design for Assembly (DFA) is an approach to reduce the cost of the product and time of assembly by simplifying the product and process. The DFA method should be considered at all stages of the design process especially in the early stages (Boothroyd *et al*., 1994). The DFA tool needed to effectively analyze for ease of assembly of the products or subassemblies.

In the analysis of a product design for ease of assembly, it depends on whether the product is to be assembled manually, with special-purpose automation, with general purpose automation, with a general-purpose automation (robots), or a combination of these (Boothroyd *et al*., 2002). In addition, some operations have to be carried out manually and it is always necessary to use the manual assembly costs as a basis for comparison.

2.2.1 DFA Guidelines and Principles

The DFA guidelines are very useful when improving the product parts for the ease of assembly. The DFA guidelines can be summarized as below (Otto and Wood, 2001).

1. Minimize part count by incorporating multiple functions into single parts.
2. Modularize multiple parts into single subassemblies. (see Fig. 2.3)
3. Assemble in open space, not in confined spaces. Never bury important components.
4. Make parts to identify how to orient them for insertion.
5. Standardize to reduce part variety. (see Fig. 2.4)
6. Maximize part symmetry. (see Fig. 2.5 (a))
7. Design in geometric or weight polar properties if nonsymmetric.
8. Eliminate tangly parts. (see Fig. 2.5 (d))
9. Color code parts that are different but shaped similarly.
10. Prevent nesting of parts.
11. Provide orienting features on nonsymmetries.
12. Design the mating features for easy insertion. (see Fig. 2.1)
13. Provide alignment features.
14. Insert new parts into an assembly form above.
15. Insert from the same direction or very few. Never require the assembly to be turned over.
16. Eliminate fasteners.
17. Place fasteners away from obstructions.
18. Deep channels should be sufficiently wide to provide access to fastening tools. No channel is best.
19. Providing flats for uniform fastening and fastening ease.
20. Proper spacing ensures allowance for a fastening tool.

Most effective DFA guideline is to “Simplify the design by eliminating all unnecessary separate parts” (Otto and Wood, 2001)

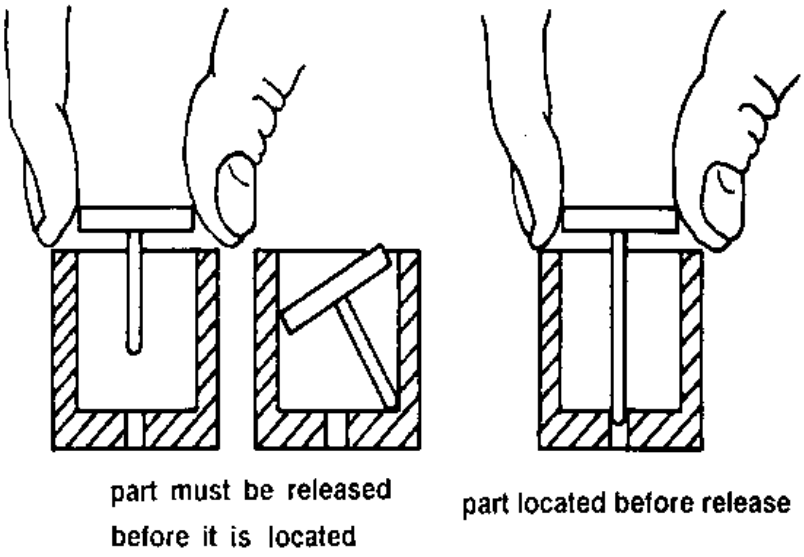

Figure 2.1: Design to aid insertion. (Boothroyd *et al*., 2002)

Source: (Boothroyd *et al*., 2002)

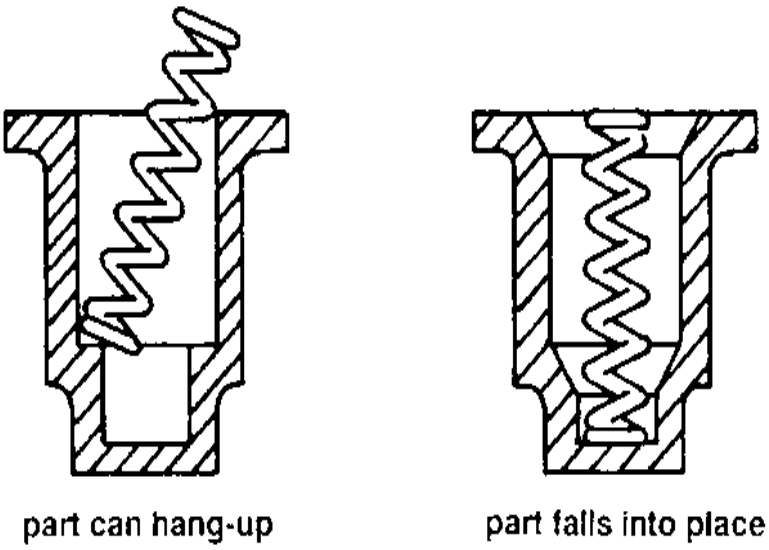

Figure 2.2: Provision of chamfers to allow insertion.

Source: (Boothroyd *et al*., 2002)

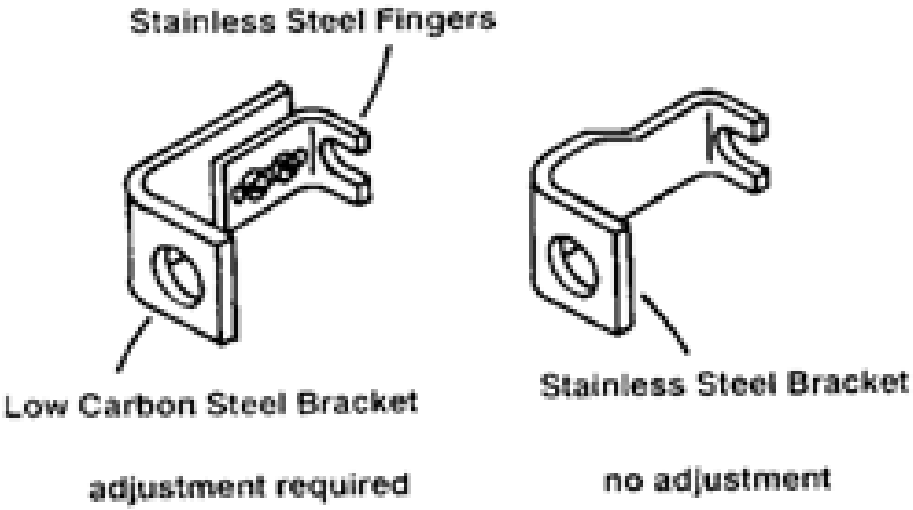

Figure 2.3: Design to avoid adjustment during insertion

Source: (Boothroyd *et al*., 2002)

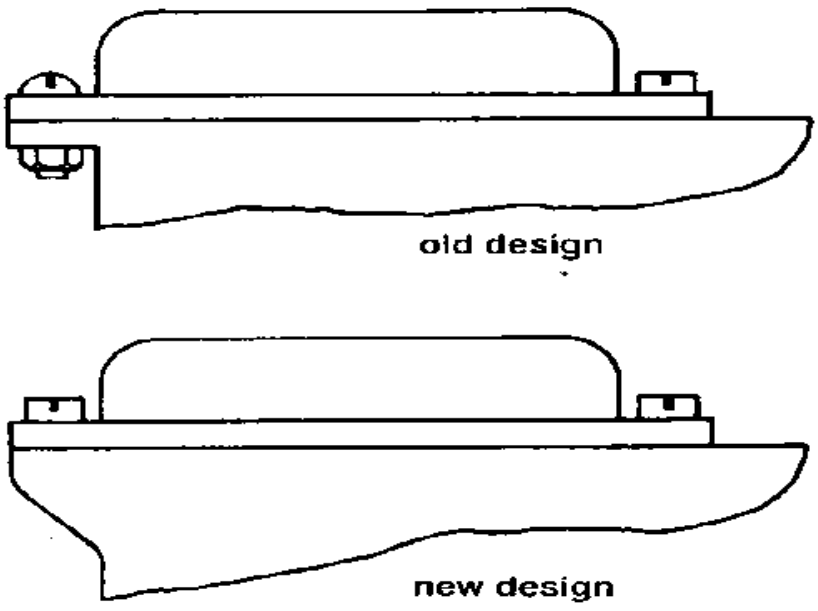

Figure 2.4: Standardize parts.assembly.

Source: (Boothroyd *et al*., 2002)